UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Washington 25, D. C.

REPORT ON THE RECONNAISSANCE SEDIMENTATION SURVEY OF RADFORD RESERVOIR, RADFORD, VIRGINIA

By

L. C. Gottschalk

Associate Geologi .

Special Report No. 7

Sedimentation Section

Office of Research

November 1944

REPORT ON THE RECONNAISSANCE SEDIMENTATION SURVEY

OF RADFORD RESERVOIR, RADFORD, VIRGINIA

By
L. C. Gottschalk
Associate Geologist
Sedimentation Section

INTRODUCTION

This report contains the results of a reconnaissance sedimentation survey of Radford Reservoir located on the Little River, 4 miles south of Radford, Virginia. The survey was made at the request of the City of Radford to determine the effect of erosion in the Little River watershed on silting of this reservoir and future reservoirs which might be constructed on this stream.

The City of Radford, through Mr. C. T. Wells, Acting City Manager, supplied a boat, data on the dam and reservoir, and the services of a man to assist in the survey. This cooperation is herewith gratefully acknowledged.

HISTORICAL INFORMATION

The first hydro-electric plant serving the City of Radford was built on the Little River in 1901 by the Radford Water Power Company. The dam of wooden construction was located 775 feet above the present dam. The City of Radford entered the municipal ownership field in August 1922 when it acquired all of the properties of the Radford Water Power Company. In 1930, the city completed a Diesel power plant and in August 1934, the present hydro-electric plant. At the time of completion of the hydro plant, it was intended that the Diesel plant would serve for reserve purposes, but it now furnishes the greater amount of power for the city while the hydro plant serves as a secondary source. Comparative power generation of the two plants from July 1938 to July 1944 is shown in table 1. The increased consumption of power in 1941 resulted from establishment of war industries in this area.

Table 1. Power generation by hydro-electric and Diesel plants at Radford, Virginia[1]

Period	Power Generation	
	Hydro-electric plant	Diesel plant
	Kilowatt-hours	Kilowatt-hours
July - December 1938	2,636,500	1,706,200
January - December 1939	5,336,400	2,370,740
January - December 1940	5,302,100	2,362,300
January - December 1941	4,134,900	7,257,300
January - December 1942	3,867,800	8,157,100
January - December 1943	4,842,300	7,530,100
January - July 1944	2,745,800	4,334,310

[1] Data supplied by the City of Radford.

THE DAM AND RESERVOIR

Radford Dam

The hollow concrete ogee dam is located on the Little River 1/4 mile above the confluence of this stream and the New River. It has a maximum height of 32.5 feet above stream bed and a crest length of 263 feet. The dam has 12 buttresses spaced 22.5 apart, center to center, with 8 Tainter gates 10 feet high. The top of the Tainter gates, elevation 1772.1, forms the crest of the reservoir. There are two bottom gates in the dam, one of which serves as the intake to the power plant. The power plant, which develops 1,250 horsepower, is located at the north end of the dam, adjacent to the right bank of the stream. Normal tailwater elevation is 1732.1. The dam and the power plant were completed at an approximate cost of $150,000.

Reservoir Basin

The lake formed above the dam is a sinuous channel-type reservoir which is not much wider than the original stream channel. (See figure 1). The undercut banks along the reservoir, on the outside of sharp bends, are usually steep and in places consist of precipitous cliffs a hundred or more feet in height. On the convex

side of bends the banks are generally less steep and in many places slope gently to the water's edge. Generally the banks are well-wooded except on the inside of bends where the rolling topography of slip-off slopes permits clearing and cultivation.

The reservoir at crest elevation is 3.6 miles long. The lower third of the reservoir is, generally, about 300 feet wide with a maximum width of about 500 feet in the vicinity of range R11-R12. Above range R11-R12 the reservoir narrows to a prevailing width of a little over 100 feet which is comparable to the width of the original stream channel. The surface area of the reservoir at crest elevation, as determined from a map supplied by the City of Radford, is 113 acres. The original gradient of the stream through the reservoir area was 11.8 feet per mile or 0.22 percent. This has been reduced by sedimentation to a present gradient of 8.1 feet per mile or 0.15 percent.

The original wooden power dam had a height of about 30 feet and formed a reservoir of approximately 43 acres at elevation 1760. It is reported to have been completely filled with sediment at the time the dam was breached. The exact date of failure could not be ascertained, but according to residents of this vicinity all of the sediment accumulated above the dam was scoured out before the present reservoir was formed.

THE WATERSHED

Physiography, Geology and Soils

Little River rises on the western slope of the Blue Ridge Mountains and flows northwesterly for a distance of 50 miles to the New River from whence its waters are carried to the Ohio River and finally to the Gulf of Mexico. The watershed above the reservoir comprises 329 square miles, of which 75 percent is located in Floyd County, 20 percent in Montgomery County and 5 percent in Pulaski County. It is fan-shaped with a length and maximum width of 22 miles. Elevations vary from 1730 feet at the dam to more than 3000 feet on mountain summits.

The upper three-fourths of the watershed is in the Blue Ridge Mountain province and the lower one-fourth is in the Appalachian Valley and Ridge province. The Little River in the Blue Ridge flows in a more or less wide U-shaped upland valley. In crossing the Appalachian Valley and Ridge province it flows, generally, normal to the trend of long parallel folds of formations which have a variable resistance to erosion. Its course through the Appalachian Valley and Ridge province is tortuous as it alternately follows structural valleys and crosses formations through deeply incised water gaps. In some cases, for example, at Graysonton, Va. the stream flows for a distance of four or five miles around spurs to double back within a quarter of a mile of itself. In this section of the watershed many steep cliffs rise sheer from the river's edge.

The Blue Ridge in this area is composed of crystalline formations of pre-Cambrian age, principally the Lynchburg gneiss of the Glenarm series. These give rise to heavy but friable, shallow residual soils having characteristics strongly influenced by the nature of the parent rock. Limited areas of alluvial soils occur adjacent to the Little River and tributaries in the upper part of the watershed. Exposures of these soils by stream-bank erosion show buried old soil profiles which indicate that the general level of these valleys have been raised by sediment deposition since land clearing was initiated. The topography in the Blue Ridge is rolling to mountainous and the drainage is well developed.

The rocks of the Appalachian Valley and Ridge province consist of strongly folded and faulted quartzites, shales and limestones of Cambrian age which trend northeasterly across the watershed. The limestones and soft shales have been eroded to form the valleys, leaving the more resistant quartzites as mountain ridges. The topography is rolling to roughly rolling and, in places, mountainous. The complex geological structures of this region give rise to equally complex soil types. The soils are generally silt loams of variable depth, being shallow on steeper slopes and thicker in the valleys. Alluvial soils along the main stream are restricted to small localized areas where physiographic conditions are favorable to their formation. In this physiographic province, modern sediment also overlies pre-agricultural soil horizons on certain tributaries which flow for the most part in structural valleys parallel to the trend of the formations.

Land Use and Erosion

The Little River watershed is predominently rural. About 85 percent of the area is farmland. Floyd, Va., seat of Floyd County with a population of about 500, is the principal town.

Since about 75 percent of the watershed is located in Floyd County, it is believed that the following land use statistics given in the 1940 Census of Agriculture for this county are fairly representative of the land use for the entire watershed:

	Percent
Cropland	20.4
Cropland, idle or fallow	1.6
Plowable pasture	42.2
Woodland	23.1
Other	12.7
	100.0

A utilitarian soil conservation survey was made in July 1944, of that part of the Skyline Soil Conservation District located in the Little River watershed in Montgomery and Pulaski Counties, Va. This survey, covering 54,835 acres, or 26 percent of the total area of the Little River watershed showed the following land use:

	Percent
Cultivated	28.7
Idle	6.5
Pasture	36.0
Woods	28.8
	100.0

Much of the open farmland is used for grazing of beef cattle and sheep. General and animal-specialty farming are the principal types of agriculture. Principal crops in order of importance are hay, corn and small grains. The average size of farms in Floyd County is 91 acres. A substantial number of the farms in the Little River watershed are of the subsistance type.

Sheet and gully erosion are widespread over areas of steep mountain land which has been cleared of forests for use as pasture or cropland. Many pastures are located on slopes and soil unsuited for such use. Poor management and overgrazing has resulted in the rapid removal of surface soil and the formation of deep raw gullies. A severely eroded area may be seen 7 miles north of Floyd, Virginia, where hillside pastures have been slashed by many deep gullies. Poor farming practices on cultivated lands have also resulted in the removal of much surface soil leaving galls where crops will no longer grow. It is not unusual to see fields on 30 to 40 percent slopes with corn rows running up and down the hillside.

The use capability of land according to present land use as determined by the utilitarian survey of July 1944 is shown in table 2. Out of a total of 15,736 acres at present under cultivation in the area surveyed, only 6,315 acres, or 40 percent are suitable for safe, long-time cultivation. Of the remaining 60 percent, 3,835 acres, or 24 percent, are suitable for limited cultivation with intensive practices and 5,586 acres, or 35 percent, should be retired to permanent vegetation that may be used for grazing or woodland. Of the 6,315 acres suitable for safe long-time cultivation, 4,636 acres, or 73 percent, require intensive conservation practices. These statistics show that the area is seriously over cultivated. In addition, conservation practices have not been installed on those areas suitable for cultivation and, consequently, erosion is progressing at a rapid pace.

Normal geological stream channel erosion is relatively active along the main stream and on many tributaries. Road cuts are another source of considerable erosion. Because of the hilly terrain the construction of primary and secondary roads requires deep cuts which, for the most part, are left with steep and unvegetated slopes. In

Table 2. Use capability of land according to present land use, Skyline Soil Conservation District, Little River watershed, Virginia

Land capability	Class	Land use: Cultivated Acres	Cultivated Per-cent	Idle Acres	Idle Per-cent	Pasture Acres	Pasture Per-cent	Woods Acres	Woods Per-cent	Total Acres	Total Per-cent
Suitable for cultivation with:											
No special practices	I	713	1.3	39	0.1	161	0.3	11	0.02	924	1.7
Simple practices	II	361	.7	24	.04	245	.4	60	.1	690	1.2
Simple practices (chiefly drainage)	IIA	605	1.1	51	.1	1,030	1.9	15	.03	1,701	3.1
Intensive practices	III	4,636	8.4	400	.7	3,520	6.4	677	1.2	9,233	16.7
Suitable for occasional or limited cultivation with:											
Limited use and intensive practices	IV	3,835	7.0	251	.5	2,453	4.5	405	.7	6,944	12.7
Not suitable for cultivation. Suitable for grazing with:											
No special restrictions or special practices (wet land)	VA	40	.1	27	.1	209	.4	4	.01	280	.6
Moderate restrictions in use	VI	1,668	3.0	285	.5	1,179	2.2	922	1.7	4,054	7.4
Severe restrictions in use	VII	3,878	7.1	2,480	4.5	10,943	20.0	13,708	25.0	31,009	56.6
Total		15,736	28.7	3,557	6.5	19,740	36.1	15,802	28.7	54,835	100.0

many places channels have been dug below these cuts to carry off excess surface water. The banks are continually caving and eroding and the ditches beneath them are scouring. Although roads cover considerably less than 1 percent of the total drainage area they make a sizable contribution of sediment to the Little River.

HYDROLOGY

Precipitation

The mean annual precipitation at Radford, Va. for the 31-year period, 1906-1937 was 37.26 inches. The average annual precipitation for the entire watershed is probably several inches higher.

Stream Flow

The U. S. Geological Survey maintains a stream gaging station on the Little River at Graysonton, Va., 3 miles above the head of backwater of Radford Reservoir. The mean annual discharge at this station for the 12-year period October 1928 to September 1941 was 359 second-feet.[1] The maximum recorded discharge of 17,700 second-feet occurred August 14, 1940 and minimum discharge of 28 second-feet, September 28, 1934. Discharges by water years reported in Water-Supply Papers and from preliminary unpublished data of the U. S. Geological Survey, are given in table 3. The total inflow to Radford Reservoir from the date of completion, August 1934 to the date of survey, July 25, 1944 is estimated to be 2,736,500 acre-feet, enough to completely fill the reservoir more than 1,600 times.

---

[1] U. S. Geol. Surv. Surface Water Supply of the United States -- Part 3, Ohio River Basin. Water-Supply Paper 923, p. 218, 1943.

Table 5.--Estimated sediment production rates based on surveys of reservoirs in Maryland, Virginia and Pennsylvania

Name of reservoir	State	Location	Age at date of survey	Original capacity	Watershed area	Capacity-watershed ratio	Annual storage loss	Annual 1/ sediment production
			Years	Acre-feet	Sq. miles	Acre-feet	Percent	Cu.ft./acre 2/
Prettyboy	Maryland	Baltimore	10.5	60,333	80	788	0.1	47.6
Palington	Pennsylvania	Spring Grove	1.6	63	2.91	22	3.03	45.55
Loch Raven	Maryland	Baltimore	29	65,821	303	217	.3	42.0
Hinckston Run	Pennsylvania	Johnstown	32	3,453	10.75	321	.13	27.30
Williams	Pennsylvania	York	27	2,686	42.9	63	.63	26.68
Quehmahoning	Pennsylvania	Johnstown	25	35,295	92	384	.10	26.16
Burnt Mills	Maryland	Silver Spring	7.8	170	27	6	5.96	25.53
Barcroft	Virginia	Alexandria	23.1	1,847	14.5	127	.20	17.49
Griffen	Pennsylvania	Scranton	53	1,991	3.21	620	.04	15.2
Salt Lick	Pennsylvania	Johnstown	23	2,492	11.86	210	.09	14.97
RADFORD	Virginia	Radford	10	1,646	329	5	3.8	13.0
New River Reservoirs (4)	Virginia	Byllesby	33.5	13,255	1,320	---	1.84	12.56
Edgemont	Maryland	Hagerstown	35.5	294	2.5	118	.13	10.74
Whyel	Pennsylvania	Uniontown	20	60	1.3	46	.30	10.47
Gorley	Pennsylvania	Uniontown	30	150	3.0	50	.26	9.08
Pedlar	Virginia	Lynchburg	31	1,860	33.08	56	.24	9.08
Bridgeport	Pennsylvania	Mt. Pleasant	50	612	32.5	19	.52	6.66
Indian Creek	Pennsylvania	Connellsville	32	770	109.6	7	1.09	5.24
No. 7	Pennsylvania	Scranton	69	376	13	29	.24	4.6
Gordon	Maryland	Cumberland	26.6	3,129	64	49	.12	4.12
Koon	Maryland	Cumberland	8.2	7,312	60	122	.04	3.60
Piney	Pennsylvania	Clarion	13	3/27,000	3/980	28	.14	2.60
Elmhurst	Pennsylvania	Scranton	51	3,746	34.85	107	.03	2.3
Staunton	Virginia	Harrisonburg	14	385	24.95	15	.22	2.3
Old Glatfelter	Pennsylvania	York	55	147	74.3	2	1.69	2.28
Williams Bridge	Pennsylvania	Scranton	48	1,051	5	210	.01	1.5
Fishing Creek	Maryland	Frederick	12	236	8.5	28	.03	.47

1/ Excluding area of lake.
2/ For converting cubic feet per acre to acre-feet per square mile multiply by 0.0147.
3/ Estimated.

Table 3.--Discharges of Little River at Graysonton, Va.

(Drainage area = 298 square miles)

Water year	Maximum daily	Minimum daily	Mean annual
	Second-feet	Second-feet	Second-feet
1928-29[1]	3,730	178	460
1929-30	13,200	83	410
1930-31	1,440	90	221
1931-32	1,820	50	242
1932-33	10,000	72	372
1933-34	2,460	80	212
1934-35	6,260	122	472
1935-36	6,300	130	483
1936-37	4,500	124	438
1937-38	4,770	140	424
1938-39	4,780	120	350
1939-40	8,470	90	424
1940-41[2]	890	80	259
1941-42[2]	2,570	60	241
1942-43[2]	2,850	127	299

[1] Does not include October period 1-26.
[2] Preliminary unpublished data from files of U. S. Geological Survey

RESULTS OF SURVEY

Method of Survey

The original capacity and sediment volume of Radford Reservoir was determined by the range method. Thirteen ranges were used for measurements of water depths and sediment thickness. Direct measurements of sediment and water depths were made simultaneously at regular estimated intervals along these ranges, using a sectional sampling spud attached to a sounding line upon which the depth of water could be read directly. Sediment depths along range R1-R2 were determined by comparison of the present profile, ascertained by soundings, with the original profile of the reservoir which was made in connection with construction of the dam. A total of 69 sediment observations were made over the entire lake area.

Water and sediment depths for each range were plotted on cross-sectional paper and the respective areas of each determined by planimetering. The volume of water and the volume of sediment was determined by the following formula:

$$V = \frac{A'}{3}\left(\frac{E_1 + E_2}{W_1 + W_2}\right) + \frac{A}{3}\left(\frac{E_1}{W_1} + \frac{E_2}{W_2}\right) + \frac{h_3E_3 + h_4E_4 + - - -}{130{,}680}$$

where: V = Original capacity or sediment volume, in acre-feet.

A' = The quadrilateral area in acres formed by connecting points of range intersection with crest contour between ranges

A = The lake area of the segment, in acres

E = The cross-sectional area, in square feet

W = Length of bounding range at crest elevation, in feet

h = The perpendicular distance from the range on a tributary to the junction of the tributary with the main stream or to a point where the thalweg of the tributary intersects the downstream range.

The results of a reconnaissance-type survey, such as was made on Radford Reservoir, are not comparable in accuracy to the results obtained by detailed surveys with instrumental control. However, they afford a rapid means of estimating the approximate rate of silting of reservoirs and the results are sufficiently reliable to indicate whether the useful life of a reservoir is of the order of tens, scores or hundreds of years. In 80 percent of cases, where reconnaissance surveys have been followed by detailed surveys, it has been found that the results of the reconnaissance-type survey are within 30 percent, plus or minus, of the correct value. It is believed that the results of the reconnaissance survey of Radford Reservoir are below the usual standard for this type of survey because of the extreme difficulty experienced in penetrating the silt deposits in this reservoir.

Character and Distribution of Sediment

The contact between the lake deposits and the underlying original bottom materials was generally easily recognized in the upper end of the reservoir where the bottom was bedrock or bedrock covered by flood-deposited cobbles and boulders. Below range R15-R16, the original bottom could not be determined with any degree of accuracy.

The sediment in the reservoir is very compact although it has never been exposed to drying. Along range R1-R2, where there is a known thickness of 13 feet of sediment, maximum penetration with the spud could be obtained to a depth of only 5.6 feet. Progressively greater penetration was obtained on successive ranges upstream from the dam. A maximum penetration of 9.2 feet was obtained on range R13-R14. Above this point it was possible in nearly every case to penetrate the sediment to the original bottom.

The deposits in the lower section of the reservoir consist of light to dark brown micaceous silt which dries to a fine grayish-white powder. Sediment in the upper part of the reservoir consists of clean buff-colored sand. The organic content of the sediment is high throughout the reservoir except near the upper end where easily transported material such as silt, clay, leaves, etc., is kept scoured out. Leaves, bark scalings and logs, often in a highly carbonized condition, are found in abundance throughout the area bounded by ranges R11-R12 and R17-R18.

The mechanical characteristics of the sediment in Radford Reservoir reflect the flood history of this stream since completion of the dam. Sand was encountered as far down the reservoir as range R5-R6, although this material may possibly represent deposits from the former reservoir which occupied this section of the lake. Two to three feet of fine to medium grained sand was found along range R11-R12 and fine to medium and coarse sand was found along every range from this point to the head of the lake. A deposit of coarse sand and gravel, with particles as large as 1 centimeter, was found under five feet of silt, in the center of the channel along range R11-R12. This deposit may represent the aggraded channel of the old reservoir or the delta deposit of a small tributary which enters the reservoir just above the range. The silt overlying the sand and gravel contained an abundance of leaves and other organic matter. In general, the silt deposit above range R11-R12 is underlain by 2 to 3.5 feet of sand which gradually becomes coarser upstream. Beginning at range R17-R18 sand begins to appear in the overlying silt deposits until at range R21-R22, it constitutes a major part of the deposits. Above range R21-R22, interbedded sand and silt give way to deposits that are chiefly sand until finally, near the upper end of the reservoir, the sediment consists entirely of coarse sand.

The sand in the lower two or three feet of deposits above range R11-R12 is undoubtedly a result of the high flows which occurred on this stream during the early storage history of the reservoir. During the first three years of storage there were 21 separate days during which the flow at Graysonton, Va., exceeded 2,000 second-feet, more than occurred in the subsequent seven years of storage. Not only were there more days of flow exceeding 2,000 second-feet but, for the most part these flows were much higher (See figure 2). It is believed that the high flows which occurred in the first few years of storage are responsible for the high sand content of the bottom 2-3 feet of sediment while lower flows at longer intervals, resulted in interstratification of sand, silt and clay in the overlying deposits.

Capacity Loss

Depletion of the storage capacity of Radford Reservoir is shown by the summary of data in table 4. In the 10-year period from the date that storage began in August 1934, to the date of survey July 1944, sedimentation caused a loss of 38.2 percent of the original capacity, an average loss of 3.8 percent annually. This would indicate an average annual rate of sediment production equal to 13 cubic feet or 0.46 tons per acre of drainage annually. The rate of sediment production from the Little River watershed, as compared with that of other watersheds in Maryland, Virginia and Pennsylvania is shown in table 5.

Because of the extremely low capacity-watershed ratio of this reservoir, equal to only 5 acre-feet per square mile, the trap efficiency of the reservoir is low. On the basis of analyses of data on similar reservoirs in the United States it is not likely that Radford Reservoir traps more than 50 percent of the sediment load coming into it and it is quite possible that the amount trapped may be as low as 30 percent. This would indicate that the rate of sediment production from the Little River Watershed is actually much higher, possibly 2 or 3 times as great as that indicated by the survey. Sediment is carried out of this reservoir even during periods of low flow as may be seen by muddiness of the stream below the dam. The flow of Little River during the time of survey was about 30 percent of normal, yet sediment outflow turned the water of the Little River below the dam to a chocolate brown and its flow could be seen even in the New River a mile below the confluence of these two streams. According to residents of this area this is not unusual and during periods of high flow becomes more evident.

Table 4.—Summary of data on Radford Reservoir, Radford, Va.

	Quantity	Unit
Age[1]	10	Years
Watershed area[2]	329	Square miles
Reservoir:		
Area at spillway stage:		
Original	113	Acres
At date of survey	113	Acres
Storage capacity at crest level:		
Original	1,646	Acre-feet
At date of survey	1,018	Acre-feet
Capacity per square mile of drainage area:[2]		
Original	5.0	Acre-feet
At date of survey	3.1	Acre-feet
Sedimentation:		
Total sediment	628	Acre-feet
Average annual accumulation:		
From entire drainage area	62.8	Acre-feet
Per 100 square miles of drainage area	19.1	Acre-feet
Per acre of drainage area:		
By volume	13.0	Cubic-feet
By weight[3]	0.46	Tons
Depletion of storage:		
Loss of original capacity:		
Per year	3.8	Percent
To date of survey	38.2	Percent

[1] Storage began August 1934; average date of survey July 1944.
[2] Excluding area of lake.
[3] Based on assumed dry weight of 70 pounds per cubic-foot.

CONCLUSIONS AND RECOMMENDATIONS

In 10 years, sedimentation has reduced the original storage capacity of Radford Reservoir by 38.2 percent. At the present rate of silting, and assuming that the normal channel of the stream is equal to 15 percent of the original capacity of the reservoir, it will require only 12 to 13 years more for the capacity of this reservoir above normal stream channel conditions to be entirely lost. The advantages of carry-over storage will then be gone, and operation of the power plant will depend entirely upon the current stream flow. During periods of low flow there may not be a sufficient quantity of water available for the continuous operation of the plant.

The low ratio of capacity to inflow is the principal factor accounting for the rapid rate of sedimentation in Radford Reservoir. A reservoir of this type would fill in a relatively few years with the normal bedload of the stream derived from stream bank erosion and natural geologic processes. However, clearing of steep mountain land for pasture and cropland; cutting burning and grazing of forest areas; poor management and overgrazing of pastures; and poor farming practices on cultivated land have combined with the natural erosion potentials--high intensity rains, steep slopes and erosive soils--to greatly accelerate the rate of soil erosion. The total sediment load of the stream is undoubtedly much larger than under primeval conditions. A reservoir large enough to trap most of this load would have a sedimentation rate much higher than with an adequate conservation program.

In order to protect future larger storage developments as well as the agricultural resources of the area, the conservation program already planned and under way in the New River and Skyline Soil Conservation Districts, which cover the entire watershed area, should be completed as rapidly as possible. It has been demonstrated in many sections of the country that such programs pay for themselves in benefits to the farmers as well as to owners of downstream development.

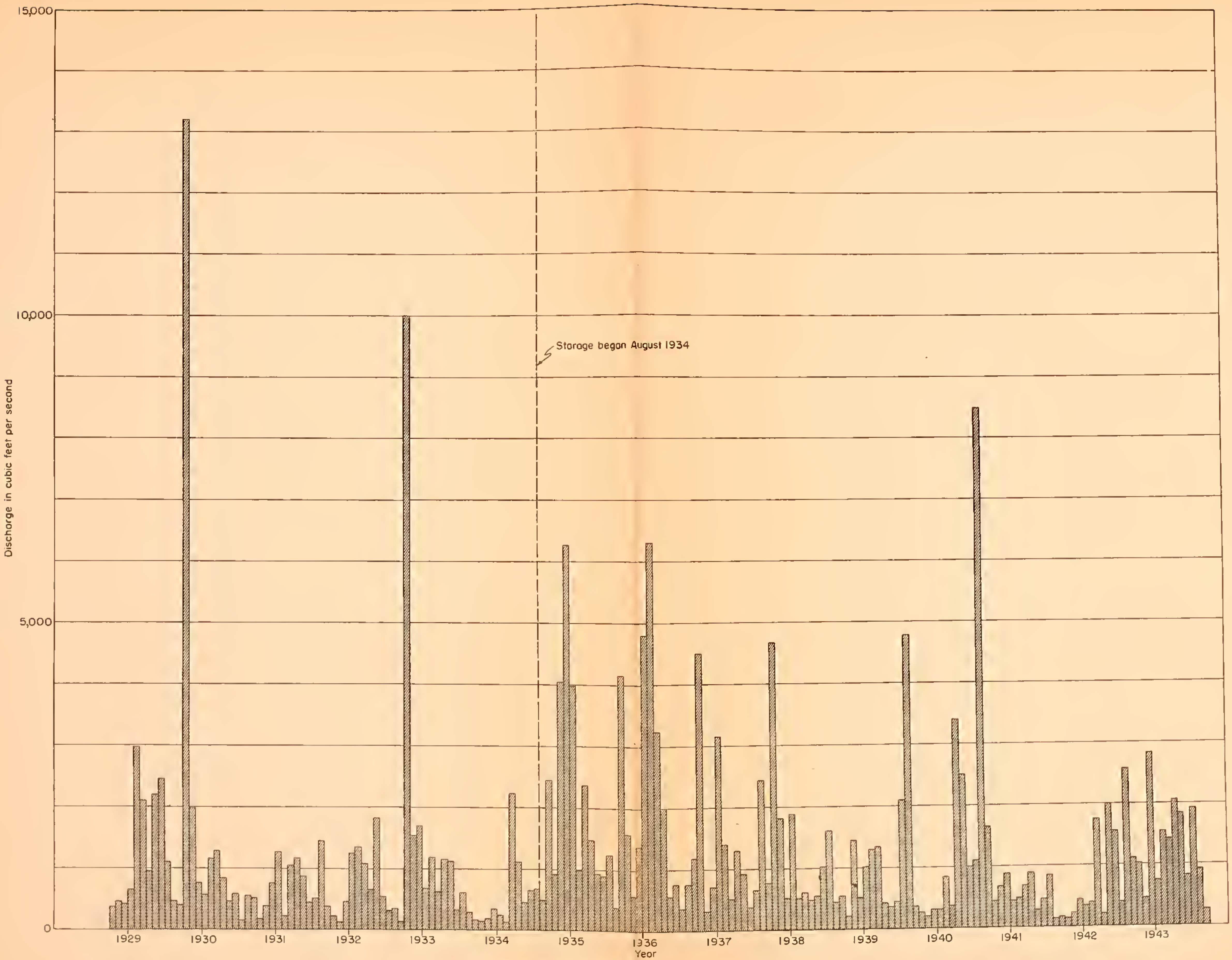

Figure 2.-Maximum daily discharge per month of Little River at Graysontan, Va.